AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

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To Subscribers.

Having advocated the principle of low fares, we are determined not to suffer our practice to fall behind our doctrine. Although our circulation from the nature of the work, is limited to those engaged, or, in any wise interested in Internal Improvement, we hope to increase the number of these, and enlist all classes in its favor. The American Railroad Journal, was commenced when but *one hundred miles* of Railway were in use in the United States. Now there are nearly *five thousand*—and having continued thus far under many difficulties, we consider that an ample guarantee has been given for its future continuance. Being desirous of strictly adopting the *cash system*, and of accomodating ourselves, to the spirit of the times we propose making the following changes.

The American Railroad Journal will hereafter be published once a month, and on the first day of each month. Each monthly number will contain 32 pages. The original matter will be printed in the same type as heretofore but not *leaded* so that each page will contain one third more than before. All selected matter will be printed in smaller type—but in general it will be our endeavor to give a condensation of foreign and domestic intelligence rather than mere selections. Each volume will therefore contain as much, if not more matter than formerly, and the result of more editorial labor.

By this arrangement the postage to distant subscribers will also be greatly reduced.

The terms will hereafter be

Three dollars a year if paid on receipt of the first number.

Five dollars for two years, if paid likewise in advance.

And Five dollars a year to those who do not pay in advance.

Subscribers who have paid five dollars in advance from July 1842 will therefore receive the Journal, until January 1844, instead of July 1843.

Subscribers who do not pay on receipt of this number, being already six months in arrears, will be charged Five dollars to July 1843.

To those of our subscribers, who, by prompt payment, or any other assistance have given us their support we return our warmest thanks, with the assurance that no effort will be spared to repay their confidence.

From various causes, and also in order to issue an extra impression of this number some delay has arisen. Arrangements are making, by which the numbers hereafter, can be sent to city subscribers, and mailed to others, on, or before the first day of each month.

The Progress of Railroads since the Commencement of the American Railroad Journal.

The History of Railroads in the United States presents one of the most remarkable instances of the rapid progress of invention which has ever been recorded. A few years since the advocates of Railroads were ranked among visionaries and schemers, but so rapid has been the growth of the system among us that the small begining and its recent date are very generally forgotten. The history of this Journal will afford evidence upon this point which may suggest useful reflections. Eleven years ago the first number of the American Railroad Journal was isued by Mr. D. K. Minor. This number contains a list of works already in construction and partly finished. As nearly as can be ascertained the following list contains the whole amount of Railroads then in use.

Baltimore and Ohio	60	miles	completed	and in use.
Albany and Schenectady	12	"	"	"
Charlestown and Hamburg about	20	"	"	"
Mauch Chunk	9	"	"	"
Quincy near Boston	6	"	"	"

Thus there were but 92 miles in use upon any of the main lines of Railroads.

So little indeed was there known, and so little could there be said on the subject that the Editor announced, that a part only of the

Journal would be devoted to the subject of internal communication —that the larger part would be occupied with literary and miscellaneous matter as prepared for the New York American. But small as the quantity of matter was, several vigorous articles might even now be read with profit, and among these we might mention those relative to the comparative merits of Railroads and Canals. Although for nearly one hundred and fifty years *tram roads* had been used for the transportation of the heaviest articles such as coal, ore and stone—it was suddenly discovered that Railroads might indeed be profitably employed in transporting passengers and *light parcels*, but that beyond this they were not able to do any thing. The arguments which were then used and which have since been urged with so much force from time to time have not been without effect.

An idea of the small amount of business connected with Railroads, at the time of the commencement of the Journal, may be formed from the fact that throughout the first volume, but three advertisements, (excepting notices to contractors,) are to be found. The first of these was by Mr H. Burden of Troy, another by Messrs. A. & G. Ralston of Philadelphia and another by Townsend and Durfee, Palmyra N. Y.—the first two of which in some shape or other have been continued, and are yet to be found upon our cover.

The Editor also thought necessary to refer to several gentlemen of this city as guarantees for the continuance of the work. Before many numbers had been issued, information from all quarters poured in and a very lively interest was felt in the undertaking. The demand for Railroads throughout the country increased and popular as well as scientific information was in request.

Let us now compare the present state of affairs with this humble commencement. There are now between *four and five thousand* miles of Railroad in use in the United States built by the expenditure of nearly one hundred millions of dollars. Eleven years ago there were but about one hundred miles in use.

There are now probably more than *five hundred* locomotive engines in use nearly all of them made in this country. Eleven years ago the few engines in use were imported from England and were of the oldest patterns. Since then fifty or more American engines have been sent abroad, some to Russia—some to Austria and several to England. Had this fact been predicted even in the most indirect manner in the first number of the Railroad Journal, it would have sealed its doom.

Eleven years ago a dead level was by many deemed necessary

on a Railroad (see p. 68, vol. 1,) and grades of 30 feet to the mile were hardly thought admissible. Now, Engines are in daily use which surmount grades of 60 and 80 feet to the mile.

Eleven years ago inclined planes with stationary power were considered the neplus ultra of engineering science—now they are discarded as expensive, inconvenient and incompatible with the free use of a Railroad.

Eleven years ago it was thought that Railroads could not compete with canals in carrying heavy freight, and even much more recently, statements to this effect have been put forth by authority. Now we know that the most profitable of the Eastern Railroads derives one half its income from bulky freight—and that coal can be carried more cheaply upon a Railroad than in canals.

Eleven years ago the profitableness of Railroads was not established and discouraged by the vast expenditure in several cases of experiment in an untried field, many predicted that they would be unprofitable. Now it is already demonstrated by declared dividends, that well constructed Railroads when divested of extraneous incumbrances are the most profitable investments in our country. The New England Railroads have paid since their completion 6 to 8 per cent.—Several other roads 6 and 7 per cent. The Hudson and Mohawk of 15½ miles costing about one million, one hundred thousand, paid in 1840 *seven* per cent. on that enormous outlay. The Utica and Schenectady, and Syracuse and Utica, pay 10 to 12 per cent. The Stock of the Utica and Schenectady Railroad has never been down to par since operations were commenced in 1836 and has maintained its stand without fluctuation at a higher rate than any other species of stock during all our commercial revolutions.

Eleven years ago there were but six miles of Railroad in use in the vicinity of Boston. Now Boston has direct connection with a web of Railways *one thousand two hundred and three miles in length*, all of which except about 24 miles are actually in use, being a greater length of Railroad than there was in the whole world, eleven years ago.

We have but one instance to record of a want of correspondence with the general advance of the system. In the first number of the Railroad Journal at the head of the list of applications to the Legislature for charters, we find the New York and Erie, and New York and Albany Railroads. Throughout the first volume, and in each succeding volume are to be found various articles in behalf of these two works. Neither of them is yet completed. One has

a portion complete, and in successful operation, the other has barely commenced construction. That these great works have not yet been finished is no fault of their friends, who have with untiring industry, advocated their claims and that of Railroads generally—and indeed we may safely say that the Railroad system has derived its impetus, in our section of the country at least—from the efforts of those who have labored in behalf of these works. Many untoward circumstances have delayed their construction—but the chief obstacle has been the singular indifference of capitalists in the city of New York—who in one way or other have sunk in this period, more money than would have constructed two works which would have rendered our city a commercial focus, unrivalled in the world.

A better feeling now exists, and we hope, ere long, to see the fulfilment of our best wishes—indeed it is no longer a matter of choice but of necessity. In the city of New York taxes have increased to such an amount that unless every effort is made to concentrate the business of the country, trade will flow through other channels, and find a more ready outlet, where enterprise and capital may direct.

We would do great injustice to the spirit of enterprise in our country, were we to omit mention of another great work which has been completed in this period—the Croton Acqueduct—one of the finest achievements of Engineering science in modern times. This magnificent work, by an acqueduct of 32 miles in length is designed to furnish an abundant supply of the purest water ever tasted by man, to the City of New York. The whole character of the work in that of solidity and utility—with no attempts at display, it impresses the mind solely by its magnitude and great value. The Acqueduct Bridge, at Harlem River when completed will not suffer from a comparison with any similar structure in the world.

When we seriously contemplate the great things which have thus been accomplished in the brief space of eleven years, can we wonder that the friends of Railroads, place unbounded reliance in that energy and spirit of enterprise which have already performed so much, trusting that in such a vast and active nation as our own the germ of prosperity will never perish, even if retarded in its growth by untoward circumstances or injured by national calamity. Nor can it create surprise that those who have endeavored to record the rapid advance of this great national enterprise, should feel enthusiastic in a cause for which they have so long labored and an honest pride in having even in the smallest degree and in the humblest manner contributed to its interest.

IMPORTANT FACTS RELATING TO RAILROADS.

With a view to the diffusion of popular information upon the subject of Railroads we have collected in this number several tables and statements which being short and readily intelligible at a glance may be considered as forming a condensation of Railway statistics. This information is drawn from various authentic sources.—We are indebted for some, to the "Sketch of a Railway" which has been several times noticed in this Journal—but all are derived from official statements, mostly recorded in this work.

PROFIT OF RAILROADS.

The Chev. de Gerstner in the years 1839–40, himself or by his assistant visited every Railroad in the United States, and enjoyed remarkable opportunities for obtaining information. We stated as the result of his observation—that notwithstanding the very short time since these works had commenced operations—and notwithstanding the difficulties of some roads arising from an insufficient capital or a deficient traffic—the average of all the Railroads then in operation in the United States was *a dividend of five and a half per cent., on the capital invested.* He also states that "on all the lines there is a yearly increase of at least 15 to 20 per cent. in the gross income, so that even those which do not pay now will give in a few years a handsome dividend." He also affirms that from the information collected there can be no doubt that the large capital invested in Railroads, will not only produce an incalculable benefit to the country, but also pay the shareholders a dividend which under good management, by the constant progressing population and trade, must likewise from year to year increase."

PROFITS OF VARIOUS RAILROADS.

ROAD.	Length Miles	Highest Grade p Mile	cost.	Annual Dividends—per cent.				
				1837.	1838.	1839.	1840.	1841.
Boston and Lowell	25¾	10	$1,834,893	7	7	8	8	8
Boston and Providence	41	37½	1,782,000	8	8	8	7	7
Boston and Worcester	44½	42	2,374,547	7½	7½	6	6	7
Lowell and Nashua	14	10	380,000			6½	7½	8
Eastern (incomplete)	60		2,267,000			5	5	6
Taunton Branch	11		250,000			7	6	7½
New Bedford and Taunton	21		400,000				6	6
Norwich and Worcester	58½		1,777,471				6	6
Petersburgh and Roanoke	60		826,000			9		7
Georgia Railroad	47		2,350,000					6
Camden and Amboy	92		2,291,802	18⅔ per cent per ann. It has earned its cost in 7 years.				
Mohawk and Hudson	15⅞		1,000,000	7 per cent in 1840.				
Syracuse and Utica	53		893,889	pays 10 to 12 per cent annually.				
Utica and Schenectady	78		1,900,000	pays 11 per cent annually and reserves a large fund, by which it is constructing a econd track.				

The *Utica and Schenectady Railroad* has yielded, on an expenditure of $1,900,000, in 5 years and five months, the sum of - - - - - - - $2,019,979

The whole amount of expenses during the same period, besides paying for the purchase of the Mohawk Turnpike, building 22 miles of road for turnouts, and paying severe taxes, was - - - - - 707,694

Nett receipts in 5 years and 5 months $1,309,285

The *Camden and Amboy Railroad.* By an *official* report from the company, it is shown that this road has earned its entire cost in seven years. It has, however, had to divide its earnings with the Delaware and Raritan Canal, with steamboats and wharves at its two extremes, costing $2,829,797,—on which it had to pay dividends, as well as to its own Stockholders, on a capital of $2,291,802, expended on the Canal, and in steamboats, wharves, real estate, and coal lands, $929,055. The canal, in fact, earning on $\frac{5}{8}$ths of one per cent.

The gross receipts over the Camden and Amboy Railroad, from 1st Jan. 1833, to 31st Dec. 1839, was $4,637,535

The gross expenditures during this period. $2,253,993

Net receipts in seven years - - - - $2,383,542

Being more than the cost of the railroad; and this too with but limited accommodations for the transportation of freight, at high charges proportioned to other railroads.

TABLE SHOWING THE LENGTH OF RAILWAYS RADIATING FROM, AND IN CONNECTION WITH, THE CITY OF BOSTON.

		Distances
From Boston, via Albany, to Buffalo		518 miles.
do.	Portsmouth, to Portland, Maine	104 "
do.	Lowell, Nashua, and Concord	62 "
do.	to Providence, Rhode Island	41 "
From Providence to Stonington		47 "
Branch from Andover to Haverhill		25½ "
Dedham Branch		2 "
Taunton Branch, and extension to New Bedford		35 "
Bedford and Fall River		13 "
Norwich and Worcester		58¼ "

New Haven to Hartford, 36, and extension to Springfield 24 miles, not completed	60 "
West stockbridge to Bridgeport	98 "
West Stockbridge to Hudson	33 "
Troy to Shenectady	22 "
Troy to Ballston	20 "
Shenectady and Saratoga	21 "
Lockport, Niagara Falls, and Buffalo	43 "
Miles,	1,203½

INCREASE OF INCOME ON RAILROADS.

The following table proves that the assertion of the Chev. de Gerstner was correct—that Railroads which are not yet profitable may become so before long, and that those which now pay well, will hereafter produce a still higher profit.

Boston and Lowell, nett revenue, 1836, 89,800
do. 1839, 149,100

$59,300 increase in 3 years.

Bost. and Worces'r. gross revenue, 1835, 119,100
do 1839, 231,800

$112,700 increase in 4 years.

Baltimore and Ohio, gross revenue, 1833, 195,700
do 1840, 432,900

$237,200 increase in 7 years.

Camden and Amboy, nett revenue, 1833, 181,000
do 1839, 427,000

$246,000 increase in 6 years.

Liverpool and Man.'r, nett rev., 1832, 303,000
do 1839, 556,000

$253,000 increase in 7 years.

Columbia and Philadel., nett rev., 1835, 229,351
do 1840, 449,267

$219,916 increase in 5 years.

Liverpool and Manchester opened Sept. 1830. } In ten years the receipts had increased
1840. } 240 per cent.
Grand Junction, " July, 1837. } In three years the receipts had increased
1840. } 90 per cent.
London and Birmingham, " Sept. 1838. } In two years the receipts had increased
1840. } 65 per cent.

Boston and Lowell, revenue from passengers 1837, $117,682
1840, 145,953

$28,311 nearly 5 p. ct. p. an.

Income from freight 1837, $63,137
1841, 121,588

$58,451 or 19 p. ct. p. ann.

Lowell and Nashua Income from freight 1839, $18,406
1841, 56,764

$38,358 or 70 per ct. p. an.

PROPORTION OF EXPENDITURE TO INCOME.

NORTHERN ROADS—PASSENGERS ALMOST EXCLUSIVELY.

	Miles.	*Gross Receipt per annum.*	*Expense per annum.*	*Through passengers per annum.*	*Per cent. of expense on gross receipts.*	*Dividend in 1839.*
Utica and Schenectady,	78	400,700	113,700	130,000	28	11 p. ct.
Utica and Syracuse,	53	251,200	69,300	122,000	27 1-2	11
Mohawk and Hudson,	16	150,500	68,000	188,000	45 1-4	7
Camden and Amboy,	92	685,300	258,000	182,000	39	7
		$1,487,700	509,000	Average 34 1-4 per cent.		

EASTERN ROADS—ABOUT HALF OF RECEIPTS BEING FOR FREIGHT.

Boston and Lowell,	26	241,200	92,100	38	8 p. ct.
Boston and Providence,	41	312,900	93,600	30	8
Boston and Worcester,	44 1-2	231,800	126,400	54 1-2	6
Taunton Branch,	11	58,000	40,700	72	6
Eastern Railroad,	25	125,600	53,200	42 1-4	4 3-4
Nashua and Lowell,	14 1-2	55,000	29,900	54	6
		$1,024,500	435,900	Average 42 1-2 per cent.	

SOUTHERN ROADS—RECEIPTS MAINLY FROM FREIGHT, EXCEPT THE LAST AND FIRST.

Balt. and Washington,	40	202,700	85,200	42	7 p. ct.

Baltimore and Ohio,	68	433,000	280,200		65	4 1-2
Georgia Central,	110	113,600	34,400		30	8
Georgia Railroad,	87 1-2	184,600	70,300		38	9
Balt. and Philadelphia,	93	490,500	164,100		33 1-2	7
		$1,424,600	634,200	Average 44 1-2 per cent.		

From the above variety of proportions borne by the *general expenses* to the gross receipts of railways, we gather that 40 to 45 per cent. would be a fair average for the roads here enumerated leaving 60 to 65 per cent. to pay interest on loans and dividends on capital. But it should be remembered also, that at very little over that ratio of expenditure, a larger business could be done, and larger profits divided. This idea will be more clearly conveyed by stating the fact, that on the Grand Junction railway, in England the cost of motive power was reduced $45,000, and the receipts at the same time increased $70,000 in the year 1840, as compared with 1839. This and some other English roads justify about the same average ratio of expenses, of 40 to 45 per cent., but they are there burthened with government dues, etc., from which our roads are comparatively free.

CAPACITY OF RAILROADS FOR FREIGHT.

To show the immense capacity of a railway, having the drawback of grades of 50 feet, at which stationary power is used, for carrying freight and passengers, we cite the Stockton and Darlington in England, over which there passed in one year,

200,000 passengers.
690,000 tons,

principally coal, which is carried 25 miles, about, at a rate exactly equivalent to $2 per ton, for 100 miles. It makes 14 per cent. clear, and divides 10 per cent., 4 per cent. being reserved as a sinking fund. The price of the stock is £275 for £100 paid. The loads per trip carried over this road are about 65 tons nett of coal, of which they make three per day. The weight of rail on this road which has been in operation fifteen years, was originally only 26 lbs., but it has since been increased to 64 lbs per yard.

CAPACITY OF LOCOMOTIVES FOR FREIGHT BUSINESS.

Trial loads on the Reading Railroad, at an average speed of 12 miles an hour. Engine weighing about eleven tons.

1843.	Engine. 8 wheels.	No. of cars.	Bbls of flour.	Tons of iron, etc.	Tons, Nett load freight.
Jan. 8	The Gowan & Marx	57	1573	66	213
" 15	The Minerva	85	1227	72	316

1839.					
Feb. 20	The Gowan & Marx 6 wheels.	101	2002	78	268
Mar. 6	Hitchins & Harrison	88	1588	70	228
1841.					
Feb. 5	do	102	1479	104	251
Feb. 9	do	105	1318	177	308

EXPENSE OF TRANSPORTING 200 TONS OF COAL.

The trip to and from the coal mines to occupy two days—in trains of 50 cars, at 4 tons each. No allowance is made in the following calculation for back freight. Repairs of engine and cars equal to a renewal every four years.

At an average of 2½ tons of coal for the locomotive for each 100 miles, at an average of $2½ per ton, would be	$6,25
Engine driver's pay per day $2. Fireman's $1,50. Oil 1 gallon $1,	4,50
Repairs of engine per day at a cost of 8,000,	6,75
Expense of locomotive per day,	$17,50
Expense of a car per day at a cost of about $250 per coal car, viz:—attendance, one man to ten cars, $1,25 per day, is per car,	0,12½
Oil ¾ of a pint at 90 cents., per gallon,	0,9½
Repairs to a coal car per day,	0,30
Expense of one car per day,	$0,52
Daily expense of an engine as above, $17,50 per day for two days,	$35,00
Daily expense of a train of fifty cars for two days,	52,00
Total expense of locomotive, and train of 50 cars per trip,	$87,00

These expenses incidental to transportation are less than 50 cents per ton, for a run of 188 miles, without taking into consideration the *return* loads."

COST OF TRANSPORTING PASSENGERS.

The Utica and Syracuse Railroad, 53 miles long—flat bar—carried 122,000 passengers in 1840 at a *total expense* of $69,400. Equal to 57 cents each.

The Utica and Schenectady Railroad, 78 miles long—flat bar—carried 135,000 passengers at a cost of $87,400, or 67 cents each.

Note.—These charges include all expenses of repairs of Road, Mohawk turnpike, fuel, salaries, oil, etc. etc.

TRASPORTATION OF FREIGHT IS PROFITABLE.

In England, abundant proof has been furnished upon this point; but we will cite the experience in the United States, from reports made in 1840, by distinguished engineers:—"The opinion has generally prevailed that a Road to be profitable, must have a large amount of travel, and that the only source of profit is the transportation of passengers, and that, as a general rule, the freight of heavy commodities yields little or no profit. The experience so far, on our Road, demonstrates in the most satisfactory manner the *error* of this opinion. Our freighting business is more than *double* that of passengers and the mail, and this has been done under the disadvantages of having but one train for both purposes, and consequently keep up a *speed* altogether too great for the most advantageous transportation of freight."

L. O. REYNOLDS, *C. E. Central R. R. Georgia.*

"I can now state *with confidence*, that wherever the transportation is of a mixed character such as agricultural products, general merchandize and passengers, and sufficiently large to justify the construction of a good Railway, that Railways will be found to be not only the most expedicous, *but the* CHEAPEST ARTIFICIAL MEANS OF CONVEYANCE ALREADY KNOWN."

J. EDGAR THOMPSON, *C. E.*
Report to the Directors of Georgia R. R.

STEAMBOAT EXPENSES COMPARED WITH RAILROAD EXPENSES.

Cost of Boat, $70,000, at 7 per cent.,	$4,900
Wear and tear, 12 per cent.,	8,400
Fuel, 220 trips, 40 cords per trip, 8,800 cords, at $5 per cord,	44,000
Insurance on 70,000, at 3 per cent.,	2,100
Oil, tiller-ropes, packing, etc.,	2,400
Wages—1st Captain, $1,500; 2d Captain, $600; 2 Pilots, $800; 2 Engineers, $1,000; 6 Firemen, $960; 10 Deck-hands, $2,000; Steward, $400; 12 Assistant Stewards, $1,440; and Bar-keeper, $400—in all	9,100
	70,900
Deduct interest on capital, to put it on an equal footing with the Railway,	4,900
Average trips per season of eight months, 220, equal to $300 per trip of 150 miles,	$66,000

The above then, brings the cost of running a Steamboat on the

Hudson River to $300 per trip of 150 miles, or at $2,00 per mile, being $1 for each passenger—Reduce the estimated expense 25 per cent., and there still remains 75 cents for each passenger.

A Locomotive and Train, equal to the same number of passengers per trip, including all expenses, and including an allowance for repair of road, but excluding interest on capital to fully cover all expenses, $80 per hundred miles, or at 80 cents per mile, being 40 cents for each passenger.

In Massachusetts the average cost per train per mile, where fuel is comparatively dear, is 85 cents. In Georgia the same average is 61 cents per train per mile, where fuel costs less.

COMPARAITIVE RISK OF RAILROADS AND STEAMBOAT TRAVELLING.

Mr. Lang, in a report to the London Board of Trade, shows by a number of facts, that Railways are the safest of all modes of conveyance, and more particularly safer than Steamboat travelling. From Jan. 1, to July 1, 1841, only three lost their lives from causes beyond their own control. Two suffered from their own folly and negligence—5 were trespassers on the Road, and the remaining 20 were engineers, laborers or workmen on the line of the Road. The number of passengers travelling was 9,122,000. The distance travelled was 182,440,000 miles. The number killed from causes beyond their own control being three, or one to 3,040,666 passengers, only one *passenger* lost his life for each 60,813,333 miles travelled.

COST OF REPAIRS FOR LOCOMOTIVES.

						cts.
Baldwine Engines.	5 on Georgia Railroad run	71,824	at a cost of	$5,453	or per mile	7,50
	12 do do	110,540	do	6,792	do	6,14
	8 Utica and Schenectady,	145,860	do	9,992	do	6,83
	6 on Columbia R. R. run	176,782	do	7,389	do	4,18
	3 on Phil. and Balt. run	48,065	do	523	do	1,08
Norris Engines.	2 on Phil. and Balt. run	44,580	do	787	do	1,76
Various manufacturers.	10 on New Jersey R. R. run	59,033	do	2,956	do	5
		656,684		33,892	average about 5 cts. per mile for *high velocities.*	

SUPERIORITY OF RAILROADS TO CANALS.

To correct the prejudice still exisiting in the minds of some persons we show the following data that Canals are more costly than Railroads.

Public documents but rarely meet the eye of the general reader

and private companies rather mystify than go into details, and the public never derive a clear idea from them. Railways and canals are alike implicated in this charge of want of distinctness in their reports.

We refer to the annexed official statement, to bring the reader better acquainted with the numerous items of expenditure on a canal, which are supposed by many to be a mere trifle. It should dispel such a delusion. And we ask of him, having first the leading features of the railway and canal well fixed in his mind, whether he is not struck with the *comparative exemption* from the ordinary causes of wear and tear of the former over the latter, and of the constant exposure of the canal to constant breaks and to be periodically swept away by freshets, while the railway is, or can be, generally placed aloof from such accidents or danger, and is never dormant, but actively employed the year through.

STATEMENT OF THE DIFFERENT HEADS OF EXPENDITURE ON THIRTY-TWO MILES OF THE CHAMPLAIN CANAL, IN CHARGE OF THOS. A. SHERWOOD, FOR YEAR ENDING 30TH SEPT., 1838.

Structures or Work.	Whole No.	Total cost. of Repairs
Locks,	22	6,960 54
Lock tending, (exclusive of oil,)		2,112 55
Oil for locks,		42 16
New lock gates,		754 86
Waste weirs,		15 53
Culverts, cost of old estimated,		792 45
Farm bridges,	10	2,283 75
Road bridges, cost of old estimated,	9	2,840 01
Repairing scows,	5	6405 6
Lock houses, store houses, and boat sheds,	4	16 22
Timber sheds, and moving timber,		40 05
Raising and repairing tow-pate and berm bank including repairs to slope wall,		4,721 42
Cleaning out bottom of canal during spring repairs,		1,051 03
Dams,		376 99
New slope wall,		1,543 27
Docking, new and old replaced, cost of old estimated,		6,289 60
Repairs of breaches and watching canal,		269 37
Tools' shovels, picks, crowbars, axes, wheelbarrows,		1,74 91

Other works of consequence which do not come under any of the above heads.

Building two-path wall at Whitehall, between canal and creek,	5,337 56
Excavating rock and earth above and below new lock on Wood creek,	1,595 06
Excavation for deposite of streams emptying into canal at Dunham,	644 13
Building one new and repairing old crane,	314 57
Removing old embankment at Whitehall,	288 88
Building wall at Emprey's waste weir.	244 84
Repairing guard gates,	4 07
Excavating slate near Baley's,	294 88
Superintendent's salary $850, and clerk hire 199 50,	1,049 50
Miscellaneous,	866 53
Average, $1,275 per mile,	$40,809 65

The canals in Pennsylvania particularly, are more exposed to damage and delapidation than most others, nearly all of them running parallel to rapid streams. The Erie canal, exempt from this danger, has been enabled to show a better surplus, and a lower average of annual repairs, which is made only $700 to $800 per mile per annum, by the official reports from 1826 to 1838; but much has been seemingly saved since 1835 by the enlargement, the more strongly urged by its advocates on the ground of the necessity there would soon be for renewing all its *locks*, which with all canals, are fully if not more expensive than the renewal of the *sills* and *bridges* on a railway were good drainage and good care obtains. The annual costliness of the Pennsylvania canals is exhibited in the call for appropriations in 1841 by the Canal Commissioners, as follows:

General maintenance and repairs, including $150,000 estimated damage to Deleware Division by freshet of 8th of Jan., 1841,	on 650 miles canal,	$1,072,000,	tolls in 1840,		520,000
General repairs to railways, 82 Columbia and 36 of Portage,	118 " railway,	118,000,	"	"	588,000
		$1,190,000			$1,108,400

Being equal to $1,650 per mile for the canals, and $1000 per mile for the railways. Such is the contrast of expenditures and receipts, which fully refutes the claim of some that there is less wear by water than on iron; the former being always reputed among the most destructive of elements. It excites only regret, indeed,

that a system so ill adapted to the character of our country and climate, should have been so heedlessly pursued.

DEFICIENCIES IN THE NEW YORK AND PENNSYLVANIA CANALS.

New York State Canals.	*Length in miles.*	*Deficiency from commencement to* 1840.	*Pennsylvania State Canals.*	*Lengths in miles.*	*Deficiency from commencement to* 1840.
Oswego canal,	38	268,574	Juniata Division,	130	101,075
Cayuga and Seneca,	23	146,497	Western do	105	1,821
Chemung canal,	39	241,144	Delaware do	60	51,866
Crooked lake,	8	69,817	Susquehanna do	39	172,523
Chenango,	97	479,560	North Branch do	73	327,065
Black River (unfinished)	38	58,711	Western Branch do	72	372,878
Genesee Valley,	35	122,192	French Creek do	45	129,211
			Beaver do	25	128,158
	278	1,386,495		949	1,284,597

These deficiencies include interest on cost. These deficiencies exclude interest on cost.

The mode of stating the accounts, either in Pennsylvania or New York, is not very strict, as for instance in the latter State, a recent loan of $50,000 for rebuilding the wooden locks of the Chemung canal, and several other items, are charged to *funded debt*, and the new work in locks, aqueducts, etc., on the Erie enlargement, is in lieu of repairs that must otherwise have been incurred. These large deficiencies have undoubtedly been assisted by the totally inadequate business for these particular canals, but had they been railways, even of the early imperfect structure, the result could not have been so disastrous, with their quadruple resource in *freight, toll, passengers*, and the *mail, perennial.*

Report on Dr. Earle's Process.

Sir,—The following documents will explain themselves, as they are of a character to interest many of your readers. They are transmitted for insertion in the "R. R. Journal" by

Your ob't serv't,
Edward Earle.

"Ordnance Office,
Washington, Jan. 12, 1843."

"Hon. J. C. Spencer,
Secretary of War,

Sir,—I have to acknowledge the receipt of a letter from the Hon. R. H. Bayard, of the U. S. Senate, requesting to be informed of "the result of any experiments that may have been made under the auspices of the Department in relation to Dr. Edward Earle's method of preserving Timber and Cordage, together with the opinion of the Department, or of any of its officers, as to its practical value" —the same being referred to this office for a Report.

The great cost of Government Carriages and the difficulty of obtaining suitable timber for their construction, induced this office, early in 1840, to consider whether the interests of the service could not be promoted by the adopting of measures to prevent their decay. "Kyanizing" and Dr. Earle's process "were both duly considered, and the great expense of the former led to the use of the latter by authority of the Secretary of War. Since the Summer of 1840, about 70,000 cubic feet of timber have been cured at the Watervliet Arsenal, the greater part of which is deposited in store for future use. The exact cost of the operation cannot be stated, but it is believed to be about cents per cubic foot, and one and a half cents for the use of the patent right.

Sufficient time has not yet elapsed to prove the value of the process by the trials of gun carriages in service, but during the period of operations the person charged with supervising the curing of the timber (Mr. R. M. Bouton,) has made some experiments which are set forth in a printed paper published by Dr. Earle, which is hereto appended.

Mr. Boulton is a man possessed of much more science than is usually found in such a first rate practical mechanic, and full reliance may be placed in his statements.

Upon a careful examination of the subject, which its importance to this office, in a pecuniary view at least, seemed to demand, I have formed the opinion:

1. That the impregnation of timber with the sulphates of iron and copper may be effected by its immersion in a proper solution of those minerals at a moderate heat, and with timber of any size or length.

2. That timber thus cured will be in a great measure incorruptible, free from the attacks of worms, and from dry rot.

3. That its strength is not reduced, and its toughness or fibrous texture is improved.

4. That the cheapness of the process, united to its beneficial effects, promises a great reduction in the expenditures for such objects as are susceptible to its use, among which canvas and cordage seem to occupy a prominent place;—and, finally,

That this process will furnish the desideratum for the preservation of many things to which it is applicable, and should be patronized by the Government.

The letter of Mr. Bayard is returned herewith.

I have the honor to be, sir
Very respectfully,
Your ob't serv't
G. TALCOTT,
Lt. Col. Ord."

(Indorsed)

"NAVY DEPARTMENT Jan. 17, 1843."

"I unhesitatingly express my full concurrence in the opinion and recommendation of Col. Talcott within given. I have no doubt that Dr. Earle's process might be advantageously applied to a great

variety of materials used in the naval service, and that the saving to the country would be incalculably greater than the cost. I therefore strongly recommend the adoption of Dr. Earle's process, upon such terms as may be considered fair and just between him and the country.

A. P. Upshur."

REPORT.

At a meeting of the President and Managers of The Philadelphia and Reading Railroad Company on the 4th day of January, 1843, the following Report was presented, approved, and ordered to be printed for the use of the Stockholders.

To the President and Managers of the
Philadelphia and Reading Railroad Company:

GENTLEMEN,— In accordance with your resolution of the 10th inst., I have the honor to present to you the following Report:—

The entire line of the railroad, between Philadelphia and Mount Carbon, as the Board are aware, was opened for the transportation of freight and passengers, on the 13th day of January last; and on the 17th day of May following, the branch for the accommodation of the coal trade on the Delaware was opened to the Company's wharves at Richmond.

On the opening of the road to Mount Carbon, the transportation of coal was commenced, which increased on the completion of the Richmond branch until limited by the number of cars and engines then owned by the Company. A cantract was entered into on the 3d of March, for one thousand coal cars, a large portion of which it was expected would have been delivered in time for the fall trade; and contracts were also made with several different establishments for engines sufficient for their transportation The coal cars to be furnished under this contract, were not received as early as had been anticipated by the Board, and some of the engines are still undelivered. The consequence was, that the force on the road was entirely inadequate to the trade that offered. In addition to this, although the main line of the road was completed, there were numerous additions, such as extra tracks in the coal region, and at Richmond, proper connections with the branch roads, and *sideings*, for the passage of the trains on the road, etc., which were in an unfinished state during the past season, and the want o which would have been as insuperable a bar to a large business, as the want of cars and engines.

In the month of August, when the force on the road was being rapidly increased, and there was a prospect of realizing, to some extent, the expectations of the friends of the road, the operations of the Company were suspended by the destruction by fire, first of the bridge across the Schuylkill at the falls, and shortly after of the bridge across Mill Creek. These structures were rebuilt, and the trade to Richmond recommenced on the 13th of October, and from that time until the close of the shipping season, a regular coal business was done, to the extent of the cars and engines on the road.

Some disappointment has no doubt been experienced by the Board of Managers in consequence of these vexatious interruptions and delays in commencing the transportation of coal, but to some extent they were reasonably to have been expected. The contractors for building the coal cars

were energetic and efficient men, and did all in their power to complete them as speedily as possible; but it was not probable that they could obtain the requisite amount of timber, of suitable description, for so large a contract, much, if at all within the time which their contracts admitted; and experience has shown, that we cannot always rely on our locomotive builders, for the delivery of engines within the time specified by their agreements.

These difficulties, it is believed, are now to a great extent overcome. The road between Reading and Mount Carbon, which, from having been laid in the *winter*, was not in as good condition as could be desired, has been greatly improved, and the whole line of track from Mount Carbon to Richmond, and to the Columbia Railroad Bridge, is now in good condition. The bridges throughout the line, have been thoroughly examined, and every thing done which seemed likely to add to their permanency and durability; they are now in good solid condition with the exception of the one across French Creek, at Phœnixville, which, in consequence of the spans being increased beyond what was anticipated at the time of framing it, has proved less permanent than the rest. Such improvements are now being made to it, as will give it the required strength. In rebuilding the bridge across the Falls of Schuylkill, only about one-third was rebuilt on the original plan, the balance being of trusswork, supported by the piers and intermediate trusses. The timber for rebuilding, permanently, this portion of the work, is now being delivered, and will be speedily framed and in readiness to raise, but the present structure will stand any ordinary freshet. During the past summer, the track has been doubled at four suitable points, for a sufficient length to pass *two* of the longest coal trains at each point, affording with the double tracks previously laid, accommodation for the passage of ten or twelve trains per day in each direction. Additional tracks are being laid at Schuylkill Havan and at Richmond, and the trusswork is being built on four additional wharves, so as to afford every facility for speedy shipment. Arrangements are also making for some additional water stations, which will probably be required by the trade of next year, and for increasing the capacity of those already built, by the introduction of constant streams, wherever they can be commanded at any reasonable cost.

There are at present on the road twenty-four engines, (eight of which are calculated for passengers and light freight, and sixteen for coal, etc.,) and eleven hundred and thirty coal cars. The engines are sufficient for a business of six trains or about one thousand tons per day. In addition to these, a contract has been entered into with the Locks and Canals Company of Lowell, Mass., for twelve engines and four hundred and fifty coal cars, which are progressing rapidly, and will probably be delivered in the course of next spring. When this contract has been completed, together with two engines now building, and nearly finished, by the New Castle Manufacturing Company, the force on the road, for the transportation of coal, will be thirty engines and fifteen hundred and eighty cars, equal to about ten trains, or a business of about 1600 tons per day. This, it is thought, will be about as large a business as can well be accommodated, until some continuous portion of the track can be doubled; and it is extremely desirable that this should be done as soon as the arrangements of the Company will admit of it. If a double track was laid between Reading and Pottstown, a distance of eighteen miles, (of which *two* are already laid,) the trains from each end of the line could be passed in this distance, and not only would the capacity of the road be greatly increased, but the delays and irregularities which the best management on a single track cannot al-

ways prevent, would be avoided. The increased number of engines on the road will render it necessary to add to the workshop at Reading in the course of next summer. The present building was erected with a view to its extension whenever the trade on the road should require it.

From the causes mentioned in the beginning of this Report, the coal business done on the road during the past year has been much less than was anticipated, but nothing has occurred at all calculated to shake the opinion formed of its capacity, as to the amount of business that can be done, or the cheapness of transportation over it. The greatest number of coal trains yet passed over the road per day is five in each direction; a small number, it is true, compared with the anticipated trade of next year, but these were all passed at one point (Reading,) and the double track, now laid, will admit of the passage of at least double that number with nearly equal facility. The performance of the engines during the past year leaves no doubt of their being fully equal to their estimated power, their usual loads being from one hundred and sixty to two hundred tons. The experience of the past year also confirms the opinion that the cost of transporting coal from Mount Carbon to Richmond, will not exceed 50 cents per ton; at present it would appear to be less, but allowance is to be made for the cars and engines being new, and requiring less for repairs than they will after having been some time in use.

The amount of the receipts of the road for the year ending 31st December, 1842, as near as can at present be ascertained, are about $200,000, and the expenses for the same period about $118,000. A general and detailed statement of the working of the road, amount of business done, etc., will be made out and presented to the Board, but cannot be completed in time for the meeting of the stockholders.

From the preparations now making in the coal region, and the great demand for the Company's cars during the past year, there is every reason to believe that when the shipping season commences, there will be few, if any, of the unemployed at the rate of freight now charged; should this be the case, 300,000 tons would seem a very safe estimate for the amount of the coal business of next year. The receipts of the road for the past year, from sources other than coal, are about $140,000, and as it is the first year since its opening to Mount Carbon, and has been one of extraordinary depression in all kinds of business, it is probable that the receipts from the same sources for the next year will not be much less than $200,000. Should this estimate of the business of next year be correct, the receipts of the road would be about - - - - $630,000
Probable expense for the same period, - - - 220,000

Probable nett receipts for 1843, - - - $410,000

A statement of the number of cars, engines, etc., now on the road, and of those contracted for but not yet delivered, is herewith presented.

I have the honor to be,
Gentlemen,
Your ob't. serv't,
WIRT ROBINSON,
Engineer and Gen. Supdt. P. & R. R. R.

December 31st, 1842.

Cost of Transportation on Railroads. By C. Ellet Jr., C. E.

On the value of time.

In estimating the cost of transportation on railroads I have taken no account, in the preceding numbers, of an item which is generally considered of great consequence in determining the result; viz. *the value of time.* Speed is the peculiar advantage of railroads, and one which is certainly sometimes deserving of much consideration in the administration of the work. I propose to estimate its real value, as nearly as it can be done, in the transportation of passengers and merchandize.

First, then, what are we to regard as the measure of the value of time on any article of merchandize? Is it not the interest on the capital invested in the commodity, at the rate at which the proprietor estimates his profits for the time, added to the rate at which his goods depreciate in value in consequence of detention on the route?

If this be true—and I cannot well perceive what other value than this the *time* lost in their conveyance can possess—let us endeavor to ascertain to what it will amount under different circumstances; and for this purpose we will represent by

r the rate of interest, and depreciation of the value of the goods, per cent. per annum;

P the value in dollars of one ton of the commodity; and

V any velocity of transportation in miles per hour.

There are 8760 hours in a year; and if we represent this number by m, the interest and depreciation of the value of a ton of goods, in the space of one hour, will be expressed by

$$\frac{\mathrm{P}\,r}{100m};$$

and during the time the goods are carried one mile at the velocity V, it will amount to the sum

$$\frac{\mathrm{P}r}{100m\mathrm{V}}.$$

This interest and depreciation, for any other greater velocity V′, will be for the time consumed in traversing one mile

$$\frac{\mathrm{P}r}{100\,m\,\mathrm{V}'};$$

and, consequently, the difference between the values of the two velocities V and V′ (supposing that the time and speed be well employed, and that the engine drivers do not waste at the stations and depots what he gains on the route,) for each ton and for one mile, will be

$$\frac{\mathrm{P}r}{100m}\left(\frac{\mathrm{V}'-\mathrm{V}}{\mathrm{V}'\,\mathrm{V}}\right). \qquad \text{(K)}$$

This expression represents the amount which the goods would depreciate while passing over one mile, at the velocity V, over and

above their interest and depreciation while traversing the same distance at the velocity V'; or the additional sum which the owner of the goods would be willing to pay to have them carried at the speed V' instead of the slower rate V.

Now let us apply this equation to the transportation of coal, and assume for the velocity V' that which would be likely to have place on a railroad, or ten miles per hour; and for that of V the ordinary speed of a canal boat, or two and a half miles per hour; for the value of the commodity, *three dollars* per ton, and for the value of the capital employed in the trade, 20 per cent. per annum.

How much per ton per mile would the value of a speed of ten miles per hour exceed that of two and a half miles? By the equation we have here

$$\frac{3 + 20}{8760 \times 100}\left(\frac{10-2.5}{10+2.5}\right) = \frac{1}{48666} \text{ of a dollar,}$$

or a fraction more than the fiftieth part of one mill per ton per mile. It would appear, then, if this process be correct, that their is but little encouragement to tear the road, and oars, and engines to pieces—augment the risk of accident, and increase the actual cost of transportation 100 per cent.—for the purpose of delivering coal a few hours sooner than it might be effected on a canal at a speed of two and a half miles per hour. If the value of the coal be not more than three dollars per ton at the mine, and the value of the capital engaged in the trade not more than 20 per cent. per annum, the difference to the proprietor could not amount to more than the *fifth part of one cent per ton for the whole time consumed in traversing a space of* 100 *miles.*

Again, let us suppose that the article is flour, of which the value is six dollars per barrel; and let us, at the same time, assume that the depreciation would be 100 per cent. per annum: which is equivalent to the supposition that it would be entirely destroyed if it were detained one year on the passage, and that the depreciation is uniform during the whole period. We will also suppose that the speed on the railroad is infinitely great, or that a mile might be passed by a locomotive engine in a space of time so short as to be wholly inappreciable; while the speed with which the same article would be transported on a canal is, as usual, two and a half miles per hour.

What is the value of the time lost on the canal in this case? Here we have $r = 100$, $P = 6$, $V' =$ infinite, and $V = 2\frac{1}{2}$; which quantities being substituted in the equation yield

$$\frac{100 \times 6}{8760 + 100 \cdot 2\frac{1}{2}}\frac{1}{} = \frac{1}{3650} \text{ of a dollar,}$$

or about the *fourth part of one mill per mile per barrel.*

This will be recognized as rather an extreme case; but still it does not justify a high speed,—for three mills per ton per mile is generally not very perceptible among the quantities which enter into the aggregate expenses of a railroad line.

Let us next suppose the commodity to be groceries—such, for

instance, as sugar and coffee—of which the value may be assumed at two hundred dollars per ton; and that the interest and depreciation are equal to 20 per cent. per annum. In this case will find for the difference between the value of a speed of ten miles per hour, and one of two and a half miles per hour—between the speed of a locomotive and that of a canal boat,

$$\frac{200+20}{8760+100}\left(\frac{10-2\frac{1}{2}}{10+2\frac{1}{2}}\right)=\frac{1}{730}\text{of a dollar,}$$

or about *one and a third mills per ton per mile.* The difference between the value of a speed of five and one of ten miles per hour, would not in this case have exceeded a half mill per ton per mile.

A high speed, then, is not justifiable in the transportation of groceries for the purpose of saving time in the delivery of the freight. If it be adopted at all it must be because the condition of the road, or some other part of the business which it accomodates, renders it imperative, or because the injury which the work sustains in consequence of the greater velocity is not properly appreciated by the parties in control of the line.

We will next take the case of dry goods, of which the average value may, perhaps, be assumed at 2,000 dollars per ton; the interest and depreciation will again be put at 20 per cent., and the respective velocities at two and a half and fifteen miles per hour.

By the formula we have, in this case,

$$\frac{2000+20}{8760+100}\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right)=\frac{1}{66}\text{of a dollar,}$$

or one cent and a half per ton per mile.

This sum is nearly equal to the actual cost of transportation on a road in good condition; and it is therefore apparent that in the conveyance of trains composed exclusively of the most valuable goods, a greater velocity than two and a half miles per hour is always proper; but when it is recollected that there is never more than a very small proportion of the merchandize passing over a line, which possesses anything like the value here assumed—2,000 dollars per ton—the adoption of a higher velocity must still be regarded as of very doubtful utility. Even in the case pefore us—where the value of the goods is assumed at 2,000 dollars per ton—the difference between the value of a speed of fifteen miles per hour and one of six miles per hour would not amount to a half cent per ton per mile—a sum which would by no means justify a higher speed even if the train were loaded entirely with such goods.

If we apply the same method of computation to the conveyance of passengers, and estimate the average value of the time of all the individuals in the trains, at twelve cents per hour, we shall have for the difference between the value of a speed of fifteen miles per hour and the usual speed of freight boats on canals, or two and a half miles per hour,

$$12\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right)=4\ \textit{cents per passenger per mile.}$$

If the average time of all the individuals travelling be worth

twelve cents per hour, the charges on a road where a speed of fifteen miles per hour is adopted, *may be four cents per mile higher than could be demanded on one where a velocity of only two and a half miles per hour is maintained.* Of course there is a great difference between the values put on their time by different individuals; and of course too, there must be much uncertainty in fixing upon a general average. But twelve cents per hour (including the expenses incident to the trip) is by no means a high estimate for the time of all the individuals travelling in the public conveyances; but yet, low as it is, it shows for the value of the time of one person—exclusive of what mere impatience would prompt him to pay—a sum nearly two thousand times greater than that of a ton of coal, thirty times greater than that of a hogshead of sugar, and nearly three times that of a ton of ordinary dry goods, transported at the same rate.

We may perceive, then, why the superiority of railroads is so much greater in the transportation of passengers than of heavy freight; and how it may happen that a velocity which is in the highest degree economical when adopted for the convenience of travellers, may be ruinous when applied to the transportation of minerals and produce. Indeed it is difficult to over-estimate the injury which is inflicted on the interests of stockholders, from the continuance of this evil in the management of railroads, although it has been materially abated within the last four years. The value of the additional time which is consumed at the slower rate is absolutely unworthy of consideration in the conveyance of merchandize; and the only question which ought to occupy the attention of the directory is the reduction of the actual expenses of the line, and the selection of that velocity which corresponds with the greatest possible economy. The great and constant effort should be to reduce the cost of transportation to the lowest limit. It is not railroads nor canals that increase the trade of a country or add wealth to the districts which they traverse. It is the reduction of the charges for conveyance which these improvements permit, from which these great advantages are derived. And high speed on such commodities offers no compensation for the high charges which it axacts.

These considerations are applicable only to the value of time on the goods transported. But the loss of interest, and depreciation of the value of the freight, are not the only losses involved in the adoption of an insufficient speed. The value of the time of the *train, and of the train hands,* is also to be considered, and enters into the complete expression of the actual cost of transportation. If the engines and cars, and the men who conduct them, do less duty than they might accomplish by the adoption of a higher velocity, the value of the time of the increase of stock and force which will be required to effect the same duty at the slower rate, must obviously be charged against that velocity.

It is true that there are cases in which the speed to be adopted is governed by the necessity of accommodating a certain amount of

trade, or making room for a large passenger conveyance, which could not be adequately provided for on a single track, without maintaining a speed determined by the circumstances. Of course the company must submit to this necessity; they must adopt a high velocity where these or other imperative conditions exact it. But the question now is, what is the value of velocity or time, where they have the power to exercise their own discretion in the selection of the speed?

In all such cases the slower the motion of the train the less will be the expenses of the company, unless it be reduced so low that the interest on the cars and engines which convey the freight, and the loss of the time of the engine and train hands, more than compensates for the reduced charges for repairs of the road and machinery.

We will designate by F the value of the locomotive engine in dollars; by f the value of the stock in cars for each ton of freight; by m' the value of time of all the hands in the train for one hour; and by q the number of tons of merchandize in the train.

The value of one hour for the whole train will be, at 6 per cent.

$$\frac{6}{100\,m}(F+fq) + m'; \qquad (L)$$

and if we represent this quantity by H, the difference between the values of the velocity V′ and that of V, will be for each ton, and for one mile

$$\frac{H}{q}\left(\frac{V'-V}{V'V}\right). \qquad (M)$$

This is the difference per ton per mile to the company between the values of these velocities, where no imperative conditions obtain.

Now let us see what value this expression exhibits under different circumstances: and for this purpose we will put $F = 5000$; $f = 100$; $q = 50$; $m = 8760$; $m' = \frac{1}{2}$, all which are very common values, and suppose, in the first instance, that the business of the line may be transacted by an adequate supply of engines, men and cars, at some exceedingly slow rate—as half a mile per hour—how much more would it cost the company, in the value of time, to carry the trade at this rate, than at a speed of ten miles per hour?

Equation (L) gives us

$$H = \frac{11}{40}\text{of a dollar,}$$

for the value of one hour of the time of the train. This value of H being substituted in equation (M) will yield,

$$\frac{11}{40+50}\cdot\frac{10-\frac{1}{2}}{10+\frac{1}{2}} = \frac{209}{20000}\text{of a dollar,}$$

or more than one cent per ton per mile.

Now, in this case, the value of the time of the train, exclusive of the goods, is equal to half the actual cost of transportation on a well managed road with ample trade; and it is perfectly apparent

that, even overlooking the loss of time and depreciation of the price of the *goods*, such a rate is wholly inadmissible. But let us apply the equation to the determination of the difference of value of a speed of five miles and one of ten miles per hour, under the same circumstances. In this case equation (M) gives us

$$\frac{11}{40\times 50}\cdot\frac{10-5}{10+5}=\frac{11}{20000}\text{—of a dollar,}$$

or only one half mill per ton per mile—or less than the tythe of the actual difference of cost—consequent on the destruction of cars, engines and track—risk of accident and damage of goods, incident to the adoption of the greater velocity.

The whole difference between the value of a speed of five miles per hour and one of ten miles per hour, will rarely exceed one mill per ton per mile, in its effect on the interest of the value of the train, together with the depreciation of the value of the goods conveyed. However great, then, may be the inducement to carry passengers at a more rapid rate, there is no sufficient cause for transportating freight at a speed of more than five miles per hour, unless, as already premised, a higher rate is absolutely essential for the accommodation of all the trade which is commanded by the line—a condition which, on ordinary roads in this country, very rarely prevails.

We are not likely to overrate the injurious effect, or too strongly to deprecate the continuance, of the mischievous practice which still prevails in this country in the transportation of heavy commodities. The iron rails are rapidly destroyed by it; the wear and tear of the cars and engines are greatly augmented, and the useful effect of the power applied is materially reduced. There is no corresponding advantage obtained. The value of the time which is saved is almost too small to be estimated for the freight, and the value of the time lost by the train bears no perceptible proportion to the injury which is done to the road and its furniture.

Extract from Address

Delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; by A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

Prussia has undertaken to show what an "enlightened despotism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding and the culture of the beet, and the manufacture of sugar from it.

The minutiæ to which the government descends, may be perceived from the fact that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts, is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is commenced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers, have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well educated young men, whose influence on the occupations which they embrace, must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States of Germany, once loosely connected by political ties, in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines (or models of them) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various

kinds and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if one day a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Philadelphia.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world—a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts—and as entering the spacious gates. he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories only rivalled by one among ourselves, through the extensive range of rooms for the display of the materials of the arts, of models, of fabrics, of machines—through the work-shop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this* at least the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that in the arts depending upon chemistry the existence of that institution has already produced important effects, and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede or follow the theoretical instruction of the schools, is a moot-point. An intelligent iron master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there—and in Dresden, the apprentices who are pupils of the Saxon Trade School, work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice

We may admire the efforts of the Austrian and Prussian commission, but after all, the plodding spirit of routine which clogs the limbs of activity in these countries, renders the measures of success of the plans *there*, no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom

are doubtless not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons—do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending as it does through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of GREAT BRITAIN. If an Englishman's house is his castle, his workshop is its citadel. The establishment of Bolton & Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh cares little whether the colors of his dyes suit the "Glasgow folks" or the "Edinboro' gentry" or not, and Strutt does not make his woolens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbor—to keep, as far as he can, the ascendency which skill, or talent, or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions and collections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity—by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners, and address, for the striking reverse trait

which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences and to add numbers. Away with such limited views of education! Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth any thing, it is worth carrying to its full consequence. Because Burnet was brought up a blacksmith Lukens a farmer, Baldwin a jeweler, Merrick a merchant, and Merris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines and machine makers by apprenticing them to the details of filagree work, of accounts, or of pharmacy. This seems the ligitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson, of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his apparatus and a small legacy to found a more liberal school. Dr. Birkbeck endeavored to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprung up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, etc., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very pop-

ular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures, explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiences and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce esprit de corps. The results are of inestimable value in the aggregate.

The low wages of operatives generally in Europe, low relatively to the prices of conveniences, tends to keep the mass of them from intellectual improvement. Their youth is passed before they can judge of the necessity for culture, and when manhood is reached, the cares of providing food and maintenance for themselves, and usually for a family besides, press upon them so heavily, that they have time to think of little else. Until the means of life are more uniformly distributed, the mass of the mechanical population of Europe cannot become intellectual. The advantages of a different system of things, which exists with us, we should never lose sight of—never let go. It is not true that the necessaries and comforts of life are higher with us in the same proportion as our wages. The life of the American working-men is not that of the European. Besides that his inestimable political rights put him on a par as a citizen with every other citizen, he occupies a different place in the social scale—may, by education in school and out of school, put himself on an equality with any other citizen—and may have comfort and competence for himself and family. Thus relieved from the grinding pressure of want, wo to him if he slight the privileges bestowed by a bountiful Providence! Wo to him if he forget that he has a mind and soul as well as a body—an intellectual and moral as well as a physical nature!

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and their cultivators*, have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures, and the arts, exist all over our country, not supported, it is true by our great sovereign,

the people, but by a few, who are either immediately or remotely interested or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time, the commons of England gave every ninth sheep and every ninth fleece, to their ruler, to enable him to wage war; now a large portion of our commons devote at least the ninth penny to king Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue.

In different parts of our country, the modes of action intended to accomplish the great ends to which I have referred, have been various, and attended with very different degrees of success. It will be more proper, as well as more profitable, to look specially to our own doings.

TO BE CONTINUED.

SELECTIONS FROM FOREIGN JOURNALS.

Eruption of Mount Etna.—This Volcano after a rest of several years has again given signs of great internal commotion. In November the usual prognostics, the drying up of the springs, and the smoke, gave an intimation of what was about to take place. The flames were seen at Palermo, a distance of ninety miles in a direct line. No lava has yet been thrown out.

Novel Artesian Well.—An experiment is now making at the head of the Brighton chain pier, by which it is intended to obtain fresh water from below the ocean. It is expected that at the depth of seventy feet the chalk formation will be reached and fresh water obtained.

Keene's Marble Cement.—This is a combination of plaster of Paris (Sulphate of Lime) and alum. Common *boiled* plaster is steeped in a saturated solution of alum and then re-calcined and reduced to powder when it is fit for use. Although not capable of standing weather this substance is now attracting much notice from the beautiful stucco which it forms, resembling marble. It may be colored by simply mixing the color with the water used in applying it. The hardness of the substance and its beautiful polish, have brought it into use for interior decoration.

The Great Northern Steamer.—This vessel built at Londonderry is upwards of 1500 tons burthen and is fitted with Smith's Screw propellers, driven by engines of 350 horse power. She is rigged in all respects like ordinary vessels of similar size, and the steam power is considered as merely an axiliary to be used in calms, head winds etc. This mode of using steam upon the ocean, seems destined to become far more general and for most purposes more economical than the use of steam vessels as generally built.